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ABSTRACT

In this paper, discussion is restricted to indicators of educational system performance. By "educational system" is meant that system that is formally established within a country for the purpose of providing education according to the UNESCO definition of the term. What is said generally applies to indicators in other fields of the social sciences as well as to social and/or development indicators in general. The paper begins by establishing a theoretical model within which educational indicators can be defined and by discussing certain conceptual problems concerning the purposes for which indicators might be used and the methodological problems encountered in forming indicators. After a review of educational indicators developed to date, the paper develops a core of ten education indicators and demonstrates two approaches to using them to map educational systems performance across and within nations. The paper concludes by outlining research that may be conducted to extend both the core to indicators and the methodology proposed.
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INDICATORS OF THE PERFORMANCE OF EDUCATIONAL SYSTEMS

James N. Johnstone

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CONTENTS

	Introduction	7
I.	Definition of indicators	9
II.	Scope of the present paper	9
III.	A framework for defining educational indicators	10
IV.	Purposes of employing indicators	14
V.	Types of indicators	16
VI.	Methodological problems of forming composite indicators	19
VII.	Educational indices developed to date	23
VIII.	Further development of identified educational indicators	31
IX.	Directions for further indicator research	40
X.	Conclusion	42
	Appendixes	43
	Bibliography	54

INTRODUCTION

Over the past decade or so, the various disciplines classified under the broad heading of the 'Social Sciences' have become more concerned than they were previously with researching cross-disciplinary problems. Certainly research within each discipline is still concerned mainly with those problems peculiar to that discipline but increasing attention has been focussed on studies across two or more disciplines. One of the most potentially important of these cross-disciplinary research focusses has been termed the 'Social Indicator Movement'. 1/ The reasons as to how and why this movement began are numerous and not really of importance to this paper. They are traced in detail elsewhere [see, for example, Olsen (1969), Sheldan and Moore (1968) and Land (1974)].

Writers such as Bauer (1966) and Horn (1975) show that the movement gained much of its initial impetus from the NASA space project. Other writers view the Social Indicator Movement as being simply a natural development to occur at this stage in the evolution of the Social Sciences. Adelman and Morris, for example, state: "the social sciences are thus at a stage of development at which there is an overwhelming need for more exact and generally accepted empirical equivalents of the abstract, and often complex concepts in terms of which current theories of behaviour and change are formulated". (1972, p. 117) Similar comments are made by Drewnowski (1972, p. 77).

These two explanations are interwoven for elements of one can be seen in the other. Underlying each is the need for 'non-economics' oriented social scientists to have objective, valid and reliable indicators of their disciplines. If these were available, development and social change could be properly measured for the purposes of both research and planning. Sole reliance on indicators of an economic nature - such as Gross National Product - could then be discontinued or at least used only when directly appropriate to a particular situation.

With a base extending over many disciplines, the Social Indicator Movement has attracted considerable attention. All types of contributors (administrators, planners, researchers and others) have felt the need to publish their views on indicators via research monographs, journal articles, conference proceedings and books rather than perish by not becoming 'known' as being part of the movement. An incomplete bibliography on publications about social indicators to 1970 required 36 pages just to list the titles of publications to that date. A great deal more has been written since 1970. As with so many other topics in the Social Sciences (e. g. female inequality, drugs and pollution

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1/ The term 'Social Indicator Movement' is alleged to have been originated by Bauer. Although some writers prefer to use the term 'social indicator' while others use the term 'development indicator', the slight shades of meaning in the two terms are ignored in this paper and the terms are used interchangeably.

to cite just three of many examples), the Social Indicator Movement has become somewhat of a fad or an intelleetual craze. The vast majority of the literature produced in this area is about indicators not on indicators. Ways to classify indicators and general suggestions as to how they might be constructed are numerous but there are few studies dealing with the development of actual indices or researching their effectiveness in particular situations.

I. DEFINITION OF INDICATORS

One issue debated at length in the literature about social indicators is how to define the term itself. Over 40 separate definitions can be easily found - none of which is really satisfactory nor acceptable to other writers. A long academic exercise, having only limited relevance from the point of view of developing and using indicators, could be conducted by debating the finer points of these many definitions. Then the similarities, differences and nuances of meaning could be identified and (hopefully) and acceptable definition formulated. This exercise is not conducted here but is instead left for others to complete. 1/

Issues debated in presenting some of these definitions include: (i) the extent to which indicators should solely reflect output; (ii) the extent to which indicators should contain normative content; (iii) the orientation of indicators either to broad system goals or to specific goals; (iv) the relation between indicators and social policy.

In this paper, the lead of McGranahan (1972) and Horn (1975) is followed. No definition is given or accepted and the term 'indicator' is merely taken in the sense given by the dictionary for everyday usage: an indicator is "that which points out, or directs attention to something" (Oxford).

Hence an educational indicator 'points out' the extent of some identified aspect of education. The use of that indicator, and the question of what aspect is to be referred to are additional issues over and above that of the definition. They are to be discussed later.

II. SCOPE OF THE PRESENT PAPER

In this paper, discussion is restricted to indicators of educational system performance. By 'educational system' is meant that system which is formally established within a country for the purposes of providing education according to the Unesco definition of the term. In general this restriction to the formal educational system does not limit the relevance of the conclusions reached. What is said generally applies to indicators in other fields of the Social Sciences as well as to social and/or development indicators in general. Indeed references are often made to literature in these other areas. The restriction is made merely to avoid any argument which may be raised as to the applicability of certain points in a broader or different setting to that of most direct interest here.

The paper begins by establishing a theoretical model within which educational indicators can be defined. It also discusses certain conceptual problems concerning the purposes for which indicators might be used and the methodological problems encountered in forming indicators. After a

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1/ Amongst the better definitions of indicators are those found in Sheldon and Moore (1968, p. 4), Olser. (1969), in Social indicators, 1973, and Land (1974, p. 14).

review of educational indicators developed to date, the paper then develops a core of 10 educational indicators and demonstrates two approaches to using these to map educational systems performance across and within nations. It concludes by outlining research which may be conducted to extent both the core of indicators and the methodology proposed.

III. A FRAMEWORK FOR DEFINING EDUCATIONAL INDICATORS

In order to discuss educational indicators, a frame of reference must first be established. Without such a basis, the discussion could not properly identify the type of indicators that are needed nor the uses to which indicators might be put. The incongruent effects of not working from such a framework have been noted before by such writers as Kamrany and Christakis (1970, p. 208). A frame also allows a more theoretical development of indicators for it reveals those areas at present lacking data. The alternative to this approach is to work from the indicators and variables presently available on the assumption that these provide a reasonable coverage of the space presently called 'an educational system'. Such an assumption is tenuous in the extreme so the former approach is adopted here. This course of action also acknowledges the troubles associated with previous indicator usage both within and without of the education field. Drewnowski notes the following:

> "What has been created so far is an incoherent maze of variables, the definitions of which are muddled, quantification procedures questionable and practical uses, if any, extremely doubtful ... What is badly needed is the establishment of some ordering principles which would make possible a selection of useful indicators, and rejection of the ill-conceived and inapplicable ones."(1972, p. 78)

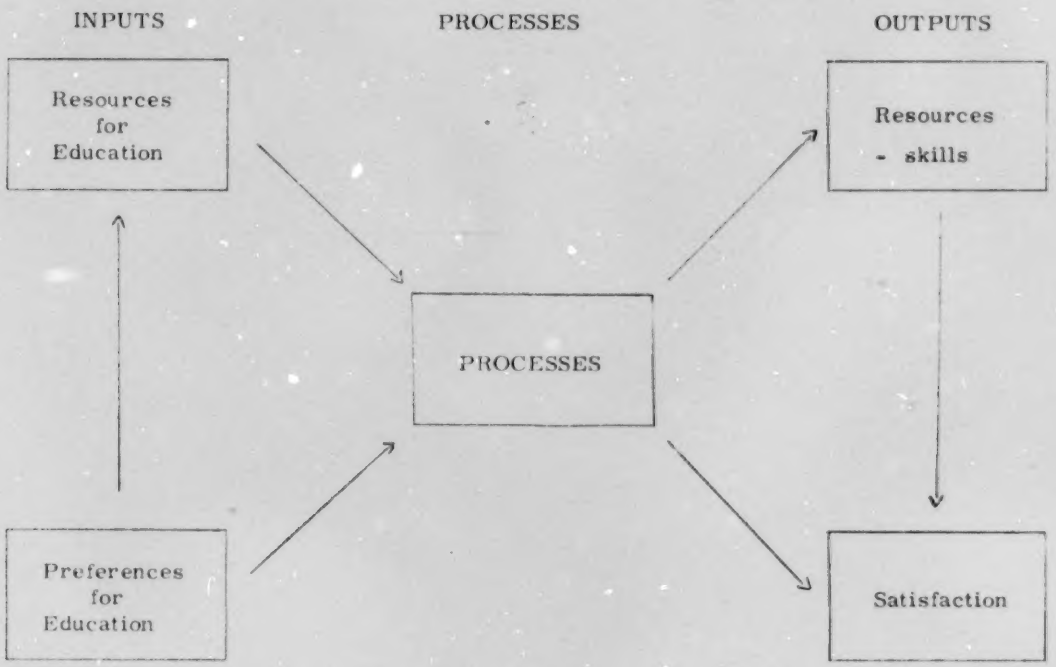
Definitions of educational systems provide little guidance on the construction of such a framework [see, for example, Unesco (1955), OECD (1967), Chesswas (1968) and Stone (1971)]. Indeed the Unesco World Survey of Education I indicates that "an inclusive definition acceptable in all countries would serve very little purpose ... (because) no two countries have educational systems identically composed and indeed any single system is constantly changing and growing". (1955, p. 32) Instead of working from such definitions therefore, a model previously established for empirical research is further refined and developed. (Johnstone, 1974)

The model suggested is based on definitions found within systems analysis theory. It thus conforms to the recommendations of a number of writers in the education field - such as Coombs (1968), Lave and Kyle (1968), Adams (1970) and Kartomo and Heckelman (1971) - for the application of systems analysis principles in the consideration of educational systems.

The model is represented in Diagram 1. It is divided into three distinct subdivisions - inputs, processes and outputs. These are considered to be quite distinct yet together they form a complete definition of the system. Thus the three subdivisions are necessary and sufficient to form the framework of an educational system.

A number of definitions of the three terms have been suggested [Andrew and Moir (1970), Banghart (1969)]. However these definitions are either of indirect usefulness in a discussion focussing directly on the educational system or they contain statements which allow equivocation in the

Diagram 1. A model for the selection of indicators of educational system performance



classification of certain indices. Hence the definitions used in the previous work are again used here:

- Educational input variables are those variables relating the amount of a particular quantity taken by an educational system to the total amount available for distribution.
- Educational process variables are those variables linking the input and output subdivisions and which indicate the distribution of the input variables throughout the educational system.
- Educational output variables are those variables relating the amount of a particular quantity leaving an educational system to the amount with some similar characteristic which is available to leave.

Defining inputs in this way ensures that they are exogenous in nature. This is not to ignore the fact that interactions may influence policy decisions and these may in turn affect the values of input variables. It is assumed that interactions within the system do not of themselves affect inputs. Hence what Adams writes in one context is considered to be impossible here: "Certain general analyses will be made, however, regarding the ways in which the internal functioning of the system affects the inputs, and vice versa" (1970, p. 14). So too is the comm[illegible]y Farrell: "enrolment ratios ... (one) rough surrogate measures of the volume of educationa[illegible]ystem output" (1970, p. 64).

Process variables reflect both the composition and the structure of the processing units as well as how and where input variables are distributed across and within these units in order to provide the outputs. From this definition, variables describing the major characteristics of educational systems are defined as process variables. So too is the way enrolments, to cite one example, are distributed throughout levels of that structure.

Output variables are those quantities flowing out of the educational system and either into one of the other systems of society or back into the educational system itself. Concern is not with the relationship or congruence of these educational outputs with the other societal systems. The present paper is only concerned, for example, with the quantity of the output of graduates from different levels of the educational system and not with whether or not those graduates are employed, what their salaries are, etc. 1/

Some may criticise the concept of this systems subdivision. The Education Committee's Working Group on Educational Statistics and Indicators of the OECD is one group who would probably disagree with the distinction being made here. They report: "it is extremely difficult, and in many instances meaningless to distinguish between ends and means, inputs and outputs in a system like education" (1973, p. 2). However, there are others who might agree with the distinction being made. For example, Noah and Eckstein (1969, p. 136) and Carr-Hill (1973, p. 1) mention the different implications of using variables measuring system inputs rather than system outputs.

The main argument the critics level is that a single variable can be an input variable in one sense, a process variable in another and an output variable in yet another sense. For example, the ratio of enrolments at the second level of an educational system to enrolments at the first level might be regarded as:

- An input variable because it indicates the relative quantities of pupils who can be expected to enter either the work force or third level education in the next few years.
- A process variable because it indicates the relative distribution of enrolments across levels within a system.
- An output variable because it indicates the proportion of students who have recently benefited from first-level education and who have remained within the system compared to those who are presently benefiting.

As conceived by the present paper, however, the classifications 'input variable' or 'output variable' are incorrect. Input variables, as defined here, must relate educational quantities back to another societal subsystem (for enrolments, this could be the number in the population). Output variables must relate quantities leaving the system to similar quantities still within the system (for example, graduates to enrolments at a particular level).

Within the input subdivision, there are two separate considerations for indicator definition and selection - one related to resources and the other to preferences. The first type of input, Resources for Education, needs little explanation. Implied here is the proportion of the relevant

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1/ In this respect then, the present model has a markedly different emphasis to that made by the OECD (1971) in their study of output indicators.

physical resources, such as manpower and finance, which is devoted to providing the system of education in a country. Examples of typical variables here include enrolment ratio or the percentage of the total national budget devoted to education. These variables are similar to the sorts of 'criteria', Poignant lists (1972, p. 28).

The second type of input, Preferences for Education, is conceptually very different. Indicators classified here do not reflect physical quantities themselves but instead the amount of those quantities a society is prepared to devote to education. Indicators of this type reveal the extent education is preferred to other nationally provided facilities such as health services, social benefits, defense services, etc. For example, a country could not have such a preference for education that its health services and facilities have to be terminated. Instead there comes a point when a country must decide, in some way, that additional expenditures in one field can only be justified after expenditures in other fields have been made but that expenditures in neither field should be allowed to fall below a certain level.

Preferences for education can be expressed by two main groups - the political sector and the private sector. These represent respectively those who provide and those who directly consume education. Generally there is a close agreement between the preferences expressed by both groups although there does not necessarily have to be congruence. In most democratic countries, the preferences expressed by the two groups can be formed relatively independently. In countries having different political systems however, the process of forming preferences can be very different and not as evenly balanced.

The differences in preferences between governments can be readily observed in a Western democracy when a change of government occurs. Then the incoming government often varies the level of expenditure which the outgoing government had previously established. Witness, for example, the changes which occurred particularly in the field of education, on the election of the Whitlam government in Australia in 1972, the Wilson government in the United Kingdom in 1974 and the Kirk government in New Zealand in 1972.

The level and nature of preferences for education within a country must affect the level of resources input into a system - hence the arrow in Diagram 1 connecting these two boxes. If both governments and individuals have strong preferences towards, for example, second-level education, enrolment ratios for this level should be high. If, however, third-level education is provided by a government but individuals see little benefit in it for them, third-level enrolment ratios would be low.

Analogies can be drawn between this type of educational indicator and those in other areas. Culyer et al (1972) define a 'need for health' indicator in their study. Drewnowski and Subramanian (1970) discuss planners' revealed preferences in development plans while Drewnowski (1970) argues for the use of preferences to be incorporated into a 'level of living' index.

Within the process subdivision, little further comment is required. Indicators of the distribution of quantities throughout an educational system are defined here as well as indicators showing the structure of the system. The one-way left-to-right arrows into the Process box in Diagram 1 represent the requirement that process variables are affected by but cannot themselves directly affect input variables.

Within the output subdivision, there are two distinct considerations. In the first of these, indicators related to the quantity and level of skills produced by an educational system are defined. They describe the relative numbers of students who graduate from a particular level or the cognitive ability of students in particular subject areas.

In the second type of output, indicators related to the level of satisfaction with the educational system are defined. In part, such indicators reveal how effective a system has been in allowing a person to develop his own skills and abilities. The indicators also reveal the satisfaction held by such groups as employers with the skills possessed by students who leave the educational system at different points.

One of the implications of the theoretical model is that some of the data required to construct indicators cannot be collected as part of the normal educational administrative procedures so often solely employed. Instead many data will have to be collected via survey and/or census methods. Although such a procedure is most unusual in the educational context, it is not unusual in the collection of economic data. In that field there are a number of series which can be determined only by interviewing samples of particular groups within the community. (See, for example, many of the series reported in Social Indicators and Social Trends).

IV. PURPOSES OF EMPLOYING INDICATORS

Within the framework of the model presented, indicators can be employed in various ways. Unfortunately these ways are seldom considered for there seems to be an implicit assumption that indicators (or very often merely single variables) are simply part of the nature of educational systems and that they must exist per se. Such an attitude clouds the proper development of indicators. Identification of their purposes helps to clarify what types of indicator should exist as well as what properties indicators should possess.

Three quite distinct purposes for educational indicators are hypothesised: (i) to monitor changes in educational systems; (ii) to assist in the process of planning system provision; (iii) to facilitate research into educational systems.

The monitoring of changes in systems is perhaps the most common purpose envisaged for indicators. It is highly desirable that changes in such features as enrolment ratios, level of female participation and the levels of comprehension of the national language should be detected as quickly as possible. If changes occur, these can either be publicised to show the favourable development of the system or remedial action can be taken before the problem is aggravated or it moves beyond the easily remedied stage.

Coombs demands that such indicators must be developed for the field of education. He sees that educational systems do not merely grow but they must change as well. Hence he posits that "one of the necessary steps toward identifying the right questions ... is to develop better instruments for assessing the performance of educational systems and their various parts ... what sorts of 'indicator' (does) an educational system need to give itself an annual check-up? Without a battery of indicators of an appropriate sort, educational planners and policy-makers have little to go on except hunch and prejudice" (1969, pp. 33-34).

The 1969 report of the National Academy of Science comments in a similar vein by recommending that "the social indicators adopted should be sufficiently precise to reflect annual changes" (p. 105). Others making analogous comments include Baster (1972, pp. 3-5), Cazes (1972, p. 20) and Culyer et al (1972, p. 94).

Change, as envisaged here, is not being attributed to a particular cause. It could therefore be change as a result of the natural evolution of the educational system or change as the result of the implementation of certain policies. Indeed the use of indicators to monitor change must be seen in a broad perspective. Too often, however, a very narrow view of educational development - and thus change monitoring - is taken. For example, the implementation of a certain policy may have certain good (direct) but restricted effects and as a result, less desirable indirect effects may also occur. One such instance would be where an attempt to increase enrolment ratios at the first level led to a fall in the percentage of total first level pupils who are female. This may not be desirable. Indicators monitoring each of these features - even though one of them is not directly included in the aim of the policy being implemented - would detect such changes. The system administrators and planners could then act according to whether they considered the attendant but unintended effect to be desirable or not. It is this use of indicators which must free them from only being goal oriented - a solitary role often held for them. Some indicators certainly must be goal oriented but there are many other aspects of an educational system which, at a particular point in time, are changing even though they are not the direct concern of a policy being implemented.

The second use envisaged for indicators is to assist in the planning process. Such a use can be as part of the formulation of plan objectives, as a basis for policy decisions or simply as a tool in the methodology used in constructing an educational plan. One of the major problems in planning, plan implementation and evaluation is the lack of plan specificity. In attempting to analyse certain features of broad planning proposals, Drewnowski (1970) for example, has to reduce his sample of 61 countries to only 14 because of the lack of statements attempting to specify exactly what the plan objectives are. Too often, unfortunately, the objectives of plans are left in vague terms such as 'to develop secondary education'. With the use of appropriate indicators, statements such as these can be precisely defined and even predictions made about the level which might be reached within the framework of a plan. For the above example two specific objectives could be framed in terms of an increase in the second-level enrolment ratio and an increase in the retention rate from the first to the final grade in that level - both increases being specified in actual values. Such specification as this in terms of particular indicators could then be used to frame policies for the implementation of a plan as well as to estimate the additional teachers required, the extra classrooms, finance, etc.

Seers sees that "the most important use of development indicators is to provide targets for planning" (1972, p. 32). Although this statement may be a little too strong, the essence of it is correct. A planner must be careful, however, in formulating a plan that he does not only recommend programmes and projects in relation to aspects he can easily quantify and ignore the more difficult or even non-quantifiable areas of education. Despite this qualification, the "planning of any action is badly impaired if its aims and prospects cannot be given a quantitative expression" (Drewnowski, 1972, p. 77). Others to commend the use of indicators in the planning process include Culyer et al (1972), Baster (1972) and Cant (1974).

The final use envisaged for indicators is to assist research into educational systems. Very often planning or administration takes precedence over research into the development of these systems and research is considered to have little or nothing to offer the practicioner. That this is so is readily evidenced by the literature. Few references are made to the proper use of indicators to explain quantitatively either the development and evolution of educational systems or the inter-dependence of the various societal subsystems such as the economic, educational, political and social subsystems /see, for example, Farrell (1970), Noah and Eckstein (1968) and Johnstone (1974-1976b)/. There are many references however to how educational systems can be administered and to how they might be planned. Despite this imbalance and its present relegated position, the research use of indicators could yet prove their most important use. If a coherent theory of societal development or a theory of educational systems development is not forthcoming, the inter-relationships between various types of indicators and the unknown effects of one societal subsystem on another could hinder social progress and negate the potential usefulness of many of the multi-lateral aid programmes. At present research in such areas is sparse and generally improperly conducted - partly because of the difficulties in quantifying such terms as 'education'. As Adelman and Morris note, variables generally used in the Social Sciences "have acquired the status of 'theoretical' constructs in spite of the fact that most of them do not have generally accepted empirical equivalents relating them to observed primary facts or data" (1972, p. 116). The use of valid and reliable indicators of educational systems would allow proper research to be conducted which was theoretically oriented and motivated.

Perhaps there are other ways in which indicators might be used. The three ways described here at least point to the main directions and begin to offer some guidance for the development of educational indicators.

V. TYPES OF INDICATORS

Having now established a framework to guide the definition of educational indicators and noted the ways in which educational indicators might be used within that frame, various types of indicators are now outlined. To date there has been a proliferation of variables which are certainly called educational indicators but the use of all of these plus those variables yet to be defined by researchers would make any use of educational indicators an exercise in chaos. The essence of the indicator development problem is not therefore in merely defining new variables or listing old ones. It is more a problem of selecting those indicators of theoretical and practical relevance.

In developing and/or selecting indicators, three main approaches can be used: (i) the choice of a representative index; (ii) the disaggregation of all indices; (iii) the formation of composite indices.

The representative indicator is the most commonly used type of indicator for research, administrative and political purposes. It involves the selection of a single variable to reflect some aspect of an educational system. The two most commonly chosen educational variables are the enrolment ratio for the first level (or the first and second level combined) and the percentage of the

Table 1. Summary of educational variables used in selected comparative education studies

Education - Economy Studies		Education - Socio-Political Studies	
Study	Education Variable	Study	Education Variable
Edding (1962)	% of GNP on education	Jahoda (1961)	Level of education reached
Svennilson et al (1962)	Enrolment ratio	Cutright (1963)	Combination of literary rates and higher enrolments per 100,000 population
Bowman and Anderson (1963)	- % of population in primary education - % of population in post-primary education	Tox and Miller (1965)	Combined first and second levels Enrolment ratios
Harbison and Myers (1964)	Combination of second and third levels Enrolment ratios	Almond and Verba (1965)	Years of schooling
McClelland (1966)	Secondary school enrolment per 10,000 population	Rummel (1972)	- Expenditures on education as a % of government budget - First-level pupil-teacher ratio - First-level unadjusted enrolment ratio - Second- and third-level students per 10,000 population

Gross National Product spent on education. Many other variables have been used. Table 1 presents a selection of some of those used in research studies investigating the inter-relationship between education and the economic, political or social subsystems. The eleven studies listed use fifteen different variables for the purpose of representing an educational system. As the correlation coefficients between pairs of these variables are all considerably less than 1.0, the use of one index rather than another could lead to differences in results obtained. For example, if Meyer (1971) had used McClelland's (1966) or Cutright's (1963) variables to relate to his crude measure of a country's economy - Gross National Product per capita - his results would be different.

The general dilemma in representing education by a single variable or a simple combination of two variables has been observed by a number of writers in the field although not so explicitly. Anderson sees that the arbitrary selection of variables for analysis by a study places a very severe limit on research. It also prevents proper comparisons being made between countries. He claims "at present we use rubber rulers to compare school systems" (1961, p. 10). Schnore, in his study of modernisation, observes that "prior research has tended to fragment the question (of indicators), for each investigator appears to have been preoccupied with one variable and to have designed his

analysis to reveal the inter-relations of one factor with all others ... almost no effort has been directed toward simultaneously ascertaining the manifold associations among a large number of indicators of modernisation" (1961, pp. 231-232). Edwards (1970, p. 251) draws the analogy that use of a single index to represent education is akin to the practice of the early twentieth century psychologists who used IQ ratings to describe the complex mental abilities of an individual.

The choice of a single variable as an indicator of education must be an impossible task. Certainly one variable could not be chosen to reflect simultaneously the five different concerns depicted in the model presented earlier. Nor could one indicator be chosen to represent each area. If this latter attempt at choice of a representative indicator was attempted, which aspect within each area would be chosen? Within the process part of the educational space, for example, consideration could be focussed on any or all of the levels of education, the female involvement component, the type of study offered or any of numerous other areas. The selection of just one of these "to represent educational system process variables does not overcome the objections raised here. As it is impossible to choose a single variable to represent a complex situation such as an educational system, the use of representative indicators must be considered as a most unsatisfactory practice for researchers, planners, administrators and policy-makers.

The second type of educational indicator involves disaggregation. Instead of selecting only one variable to represent a concept, this type of indicator requires the definition of variables for every element or component of the educational space. Ideally, every defined variable should be independent of every other variable so that information is not duplicated throughout the indicator set. The final set should also exhaust the definition of the educational system space. Indicators classified as forming a disaggregative set individually give very precise information about each element of a system but the result of completing such an exercise is a very long, complex and confusing list of indicators which is impossible to use effectively or efficiently. Some compromise to deal with only one part of the educational space raises questions of insufficiency which are difficult to answer. Additionally, it is almost certain that a parsimonious set would not be chosen and that information, especially that of a construct type, would be duplicated many times. As indicators chosen in this way do not allow proper description of an educational system for any of the purposes outlined earlier, this type of indicator is not discussed further.

The final type of indicator, and that recommended by the present paper as being the only justifiable type, is the composite indicator. This form of indicator combines, in some way, a number of educational variables. The final composite is thus interpreted as a 'kind of average' of all variables entering the combination.

Composite indicators can be regarded as possessing the best features of both of the other types. As relatively few composite indicators are needed to define an educational system space, (as is chosen later) the benefits of simplicity of description and relative ease of comprehension, which make the representative approach so attractive, are retained. On the other hand, by combining variables, particularly those that are conceptually alike, information from a broad sector of the space is conveyed. This is the same as with the disaggregative indicator, but in a much neater and more economical way.

VI. METHODOLOGICAL PROBLEMS OF FORMING COMPOSITE INDICATORS

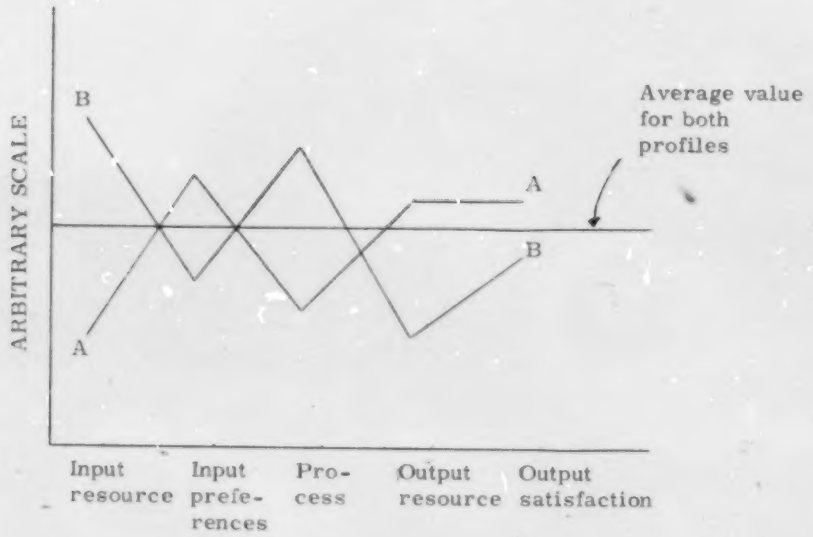
Three methodological issues (and thus three problems) arise in forming composite educational indicators. These concern: (i) the extent of aggregation; (ii) the statistical procedures used; (iii) the variables aggregated.

There is considerable disagreement over the extent to which variables should be aggregated to form a composite. Perhaps drawn by such comfortable 'stars' as Gross National Product and IQ, many writers and researchers advocate the formation of one indicator for education, another for health, another for urbanisation, and so on. Other writers even argue a total composite should be formed across broad levels of society to form an index of the level of living or welfare [for discussion of these various indices, see for example, Drewnowski (1970), Kamrany and Christakis (1970), Stake (1970), McGranahan et al (1972), Adelman and Morris (1972), and Yeh (1974, p. 5). Fachette describes this desire as a "quest for some sort of 'Gross Happiness Product'" (1974, p. 9).

When gross aggregation occurs, many difficulties arise. The most outstanding problem is that of interpretation. To demonstrate this, an (improper) assumption is made that it is possible to form a single indicator for each of the five educational areas depicted in Diagram 2. The values A and B countries each have on these five indicators are then estimated. (The cases could be continental regions, countries or any other area in which education is appropriately provided.) Diagram 2 depicts their profile on some arbitrary common scale. The countries are shown to be very different in all of the various aspects of their educational provision. An 'index of education' is now developed by calculating an average value across the five indicators. The index could also be formed using some complex weighty procedure but the point of the discussion remains valid. This level is indicated in Diagram 2. Although the 'composite index' shows the two countries have similar levels of education, the profiles show such a conclusion can in no way be reached. Hence aggregation across distinct areas within the field of education alone confounds the interpretation of a composite index. When aggregation occurs across areas which are very different in kind to form an index of the level of living for a society, interpretation becomes impossible. However, under-aggregation of variables loses much of the advantage of forming composite indicators by resulting in the formation of only a semi-aggregative set. The issue of what constitutes proper aggregation is temporally deferred.

The second issue in forming composite indicators concerns the statistical procedures to be used. As the development of indicators is still in its infancy, there is no already accepted and developed systematic statistical procedure in any of the fields described as contributing 'social indicators'. This lack is in marked contrast to the situation in economics where indicators for particular phenomenon have been developed and their characteristics investigated. Of the methods that have been used for social data, three broad approaches can be discerned. The Lazarsfield and Barton (1951) classification can be adopted to refer to these. They distinguish: (i) pragmatic reduction; (ii) arbitrary numerical reduction; (iii) functional reduction.

Diagram 2. Hypothetical profiles for two countries across the five educational areas



Pragmatic reduction is described as being the decomposition "of certain groups of combinations ... to one class in view of the research purpose" (1951, p. 119). As reduction for a particular purpose seldom leads far in the context of the development of indicators, this method is not pursued here.

By arbitrary numerical reduction is meant the selection of numerical weights for those variables to be aggregated in a way which is independent of the actual data to be used. 1/ Such selection could be based on theoretical grounds, on weightings suggested in policy documents, on arbitrarily determined values or data derived from an empirical mathematical model. In order to use such a method, an indicator has to be defined theoretically and its components identified precisely. For example, an indicator I might be defined as being additively composed of four particular variables - say V_1, V_2, V_3 and V_4. To form I therefore, these four variables must be weighted in some way so that

$$I = a.V_1 + b.V_2 + c.V_3 + d.V_4$$

If all of the Vs have the same perceived importance (and all four distributions are equated so as to have the same variances) then

$$a = b = c = d = 1$$

Adding together the values for the four defined variables thus produces the final value for indicator I.

If, however, V_1 is perceived as being twice as important as V_2 which in turn is three times more important as V_3 and V_4 (which are perceived to be equal) then

$$a = 6;\ b = 3;\ c = d = 1$$

1/ A non-educational example giving details of this procedure is Gulley and Newton (1972).

and the indicator is calculated as

$$I = 6.V_1 + 3.V_2 + V_3 + V_4$$

The final value of I is heavily dependent upon the weights assigned to the component variables (and, unless they have been equated, on the distributions of those variables). At this stage, only tentative developments have been forthcoming on proper procedures which might be used to determine such weights. Drewnowski (1970) and Drewnowski and Subramanian (1970) argue in terms of constructing a welfare index and their approach does partially overcome some of the arguments against the arbitrary nature certain methods of weighting can have. Much work in this area yet remains to be done.

The third method of forming indicators is that of functional reduction. This can be viewed as an empirical analogue of the arbitrary numerical reduction procedure just discussed. Instead of selecting weights in an a priori manner, weights are here determined by analysing a set of data and identifying the functional relationships existing there between variables. Methods such as factor analysis, cluster analysis and Guttman scaling are particularly appropriate here. When factor analysis is used to analyse data, for example, loadings for each variable are estimated on each factor. These loadings thus become the weights to be used for each variable in forming a score for each factor extracted. The factors can be regarded as the indicators.

In forming indicators by functional reduction, a major problem exists in that the data and not the underlying constructs could determine the character of the indicators. Such a bias can be introduced either by the selection of variables used or by the cases (e. g. the countries or regions) across which the analysis is performed.

Variable selection is notoriously bad in studies seeking either to develop indicators or, more generally, to identify dimensions. Very often no justification for the selection of a particular variable set is given and an ad hoc group of variables happens to be analysed. [To demonstrate this point, see studies such as those by Schnore (1961), Cutright (1963), Harbison and Myers (1964), Gregg and Banks (1965) and OECD (1971).] The result of this approach is well demonstrated by Cant (1974). In attempting "to analyse socio-economic structure and map levels of living in rural New Zealand" (p. 24), Cant selects 28 variables but gives no justification for his method of selecting these in particular and not others. He posits that, for his problem, "differences in the age and sex structure of rural New Zealand communities" (p. 37) are important and hence he introduces "an unusually large proportion of demographic variables" (p. 37). It is not surprising then that his factor analysis results in four of his five factors manifesting a predominantly demographic structure. Further complicating his analysis are the almost random associations which occur as a result of his selection procedure. For example, his indicator of 'Farming Type' describes a community having many children in the 10-19 years age-group, relatively fewer males in the 25-44 years age-group (compared to other communities) but small farms and many dairy cows and cattle. The implication of a positive relationship between young children, adolescents and cows is unclear and probably results more from Cant's ad hoc selection of variables than from some construct underlying the nature of rural New Zealand communities. Almost every study analysing variables chosen neither according to definite criteria nor within a pre-determined framework yields indicators of limited or dubious value.

The other methodological problem in forming composite indicators by the functional reduction method is that the cases themselves can determine the weights calculated. It must be expected, for example, that if data are collected for all countries across a set of variables, then analysis of the following country sets would certainly yield weights and even indicator sets which, at least in part, differed:

- all countries analysed together;
- only African and Asian countries analysed;
- only member countries of the OECD analysed.

If educational variables were being analysed, it could be hypothesised that variables related to first-level education would be more important in set 2 than in set 3 but that third-level education variables would be more important in set 3 than in set 2. These differences would yield different indicators. (For a further example of this point, see the differences in the correlation matrices calculated across various country sets and reported by Harbison et al, 1970, pp. 118-121 especially.)

Despite these two problems of variable and case selection, the analytic determination of weights does appear to offer most promise for indicator development. If variables and cases are chosen methodically and purposefully, at least a basis is formed for further development. But the essence of theory development - replication - must also be undertaken, particularly to determine if indicators identified at one point in time are still valid at another point. McGranahan et al warn that cross-national patterns are not necessarily stable cross-temporally (1972, p. 5). Adelman and Morris (1967, p. 144) and Peaslee (1969) also allude to instability as a possible problem of indicator development. However, if fairly consistent associations and weights are identified through a number of replication studies, indicators having both reliability and validity can be accepted. Indeed, in such studies, the technique of 'successive definition' as developed by Adelman and Morris (1967 and 1972) can be used with advantage especially if a technique combining the analytic and arbitrary numerical reduction methods is used.

The third issue raised in the formation of composite indices is the choice of variables to be aggregated to form an indicator. This has been discussed in part in conjunction with both of the previous issues. Certainly for the estimation of levels of education in a country, indicators must not be defined in conjunction with other subsystems of society. Education must be analysed quite separately from health or urbanisation issues to name just two other concerns. The present paper goes even further than this in its recommendation. It advocates that variables in separate areas as depicted in Diagram 1 must not be combined. So, for example, variables related to the two kinds of inputs should not be combined. Similarly, but more definitely, input and process variables must not be aggregated into the one index. Within an area, no recommendation can be made in general terms. If all variables reflect the same type of educational feature then they can be combined. Within the process sector particularly, however, many different dimensions can be identified and hence a number of composite indicators should be formed. The educational variables recommended to define each of these indicators are discussed below.

VII. EDUCATIONAL INDICES DEVELOPED TO DATE

Having established what aspects educational indicators should measure as well as the purposes for employing indicators and the various methods for indicator development, the paper now examines the literature which has either directly or indirectly attempted to develop indicators of educational systems. The purpose of this review is to establish the present availability of educational indicators and their state of development. Unfortunately the problem noted by Fanchette in a broader context exists: "there is a great laxity in the use of the term (social indicator) to the extent that most of the social statistics which are usually collected for administrative purposes are being rebaptized 'social indicators'" (1974, p. 8). To avoid confusion, therefore, educational data of the type reported in Minister's Reports, development plans, Unesco yearbooks, etc. are not referenced directly. Certainly such statistics can be used to indicate the level of very specific features but they are not the composite indices which are more powerful in describing the level of educational system provision in a country.

When a search is made for composite indicators of education, almost nothing can be found in the literature. A number of studies use a single variable or a number of single variables independently to investigate some features of educational systems and/or their development. Three studies only empirically attempt to form composites in the true sense.

The most comprehensive of these is the one by the present author (Johnstone, 1974 and 1976a). There an investigation is made into two of the five areas described earlier in the theoretical model - the input-resource and the process areas. After highly structuring the domain of both areas, a very large number of variables are defined or selected and data collected on these for both 1960 and 1969 across as many stable and politically independent countries as was possible. Factor analysing the two data sets for each year separately produces a set of dimensions (or indicators) showing considerable stability over the decade. Table 2 presents descriptions of the dimensions while Appendix I contains a summary of the variables used in the study plus the significant factor loadings obtained.

This analysis identifies at least seven features of educational system provision which are stable over time. In the resource-input subdivision of the space, the following features emerge:

- The expansiveness of a country in its educational system provision.
- The development emphasis a country places on increasing its involvement in education, particularly at the first level.

In the process subdivision of the space, the following features emerge:

- The extent to which basic education is provided and its level of refinement and quality.
- The emphasis placed on pre-school provision.
- The emphasis placed on second-level general education.
- The orientation of the courses studied by students at the third level.
- The extent of female involvement in education.

To these seven features can almost certainly be added another resource-input dimension describing a country's financial investment in education and another process dimension describing the extensiveness of development of third-level education. Perhaps even two of the process dimensions should be combined to form an index of the extensiveness of total educational development as is shown by the first 1969 process dimension.

Table 2. Summary of the dimensions of educational systems

	1960	1969
Input Dimensions	1. Expansiveness of involvement in educational provision. 2. Development of emphasis on increasing student involvement in education.	1. Expansiveness of involvement in educational provision. 2. Development emphasis on increasing student involvement in first-level education. 3. Financial commitment and emphasis.
Process Dimensions	1. Extent and refinement of basic educational provision. 2. Extent of female involvement 3. Development emphasis on second-level education. 4. Major study orientation within third-level education. 5. Development emphasis on providing equality of female involvement. 6. Extent of second-level general education. 7. Development emphasis on quantitatively expanding teacher education facilities. 8. Extent of pre-school education. 9. General quality of educational provision. 10. Extent of third-level natural science study.	1. Extensiveness of total educational development. 2. Extent and refinement of basic educational provision. 3. Relative emphasis on second-level general versus pre-school educational provision. 4. Third-level teacher education versus legal/commercial education. 5. Structural consolidation. 6. Development emphasis on higher education. 7. Development priority in basic education. 8. Development emphasis on female participation at the third level.

Each of the dimensions identified can be used as indicators. Some of them require only minimal variable aggregation as will be demonstrated. Others require more complex aggregation.

Dimensions additional to these probably also exist, particularly in the process subdivision. Lack of data prevents their identification by analytical means.

The second study forming an index of education is that by Harbison & Myers (1964). This study explicitly considers a range of educational variables which might be used to distinguish between countries. It describes the features of 7 educational variables and 6 non-educational variables, points out the extent of the availability of data on each of them and traces their behaviour in various countries at different economic and educational levels of development. The study is weakened by the almost arbitrary discarding of all but two of these variables - the adjusted second level and the unadjusted third level enrolment ratio. The authors claim these remaining variables mesure the "relative importance (of second level and) college and university education in each country". (p. 30) They also warn that "specific country-by-country comparisons (with these variables) should ... be used with caution". (p. 30) The two variables are differently combined to form a 'composite index' by which the 75 countries in the study are ranked and divided into four groups.

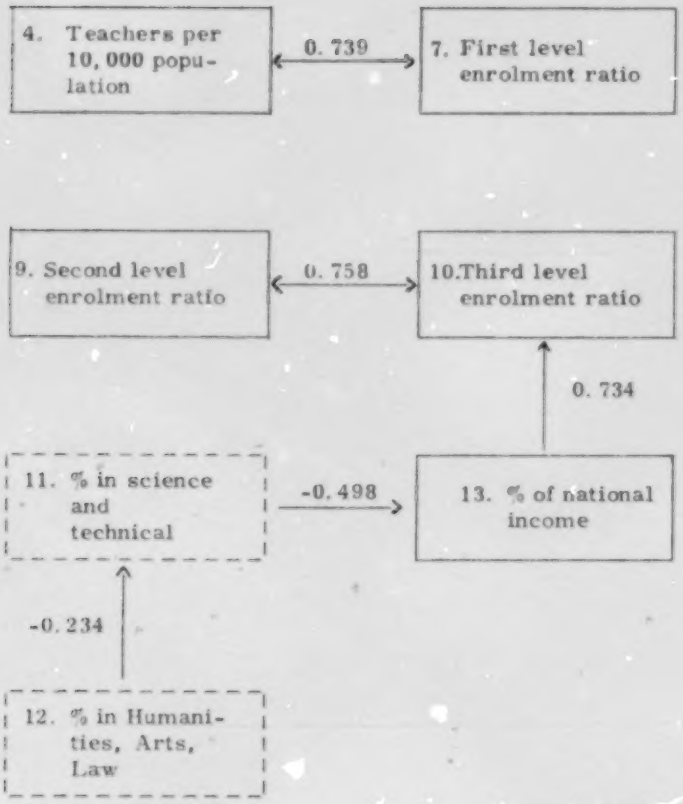
Harbison and Myers offer little justification either for selecting these two variables or for combining them in the ratio 1 to 5 for the second and third level ratios respectively. They argue that weightings of 10 and 3 for the third level variable give "somewhat different results, but not significantly different". (p. 32) The researchers fail to realise however their weight of 5 approximately equates the standard deviations for the two variables. (In the original data the standard deviations are 22.6 and 5.0 for the second and third level variables respectively.) Thus each variable contributes about 50 per cent to the value a particular country receives on the final index. [For a discussion on the analogous exercise of weighting test scores, see Terwilliger (1971, pp. 160-171) and Ebel (1972, pp. 349-351).] Hence Harbison and Myers fail to achieve their goal "that higher education should be weighted more heavily than second level in such an index". (p. 32) Even if they had achieved this goal however the argument that third level education is more important than second level "to distinguish among countries" (p. 31) is not sustained or demonstrated empirically.

The Harbison and Myers index can be viewed as being a crude form of Johnstone's first input dimension. For 1960, the correlation coefficient between the two indicators calculated across those countries common to both analyses is 0.92. This is a comparable value to some of the factor loadings defining the more refined dimension and so the Harbison and Myers' index, in part, validates the use of the 'expansiveness of involvement in educational provision' dimension as an indicator.

Although they make little reference to it, Harbison and Myers also present an inter-correlation matrix between their 13 variables. This can be analysed by using a crude cluster analysis to determine the approximate pattern of inter-relationships among the variables. The pattern for this is summarised in Diagram 3. Some support can be seen for two indicators from the groupings. The process indicator of orientation within third level education seems to faintly emerge through the lack of a strong relationship between variables 11 (Science enrolments) and 12 (Humanities enrolments) - the latter in particular having little correlation with any of the other variables. The former variable also proved of little value in the previous analysis discussed. There is again support for the expansiveness indicator by variables 4 (Teachers) and 7 (First level E.R.) joining as well as variable 9 (Second level E.R.) linking with 10 (Third level E.R.). Although less important, there is a fairly strong link between these two intra-dependent groups through variables 4 and 9. The expenditure variables (13) has an equivocal standing in the pattern. Its direct relationship is with the third level enrolment ratio but no conclusion as to its real standing can be inferred here.

The third study attempting to form indicators is that by Farrell (1969) and Adams and Farrell (1969). He develops an 'index of structural differentiation' comprised of such elements as whether a country has a proper Ministry of Education, a university level teacher training institution, university faculties in Biology, Chemistry and Physics, and a university research institute in education. Farrell arranges a number of such elements into a Guttman scale and finds that he can distinguish between countries very effectively. He claims that, because of this discrimination, "the level of such differentiation at any one point in time is a very good index of the ability of a system to adapt further". (1969, p. 295) Farrell subsequently uses his index to classify hierarchically 49 Asian, South American and African countries. He also investigates the relationship between

Diagram 3. Summary results of crude clustering on Harbison and Myers correlation matrix



Legend : 1. Input variables are enclosed in continuous outline; process variables are enclosed in broken outline.
2. An arrow from one variable to another indicates the direction of the highest correlation that variable has with all others. The value of the correlation is written above the arrow.
3. Numbers for variables are those used by Harbison and Myers (1964, p. 39).

the index and other measures of national development and again finds the index to be of considerable utility in distinguishing among developing nations (Farrell, 1970). Its behaviour in relation to the Johnstone dimensions therefore needs to be investigated.

Table 3 reports rank-order correlation coefficients between the structural differentiation of educational systems as reported by Farrell (1969, p. 309) and the educational dimensions identified for 1960. (There are twenty nations common to both studies.) None of the correlations approach a level at which they could be regarded as partially defining any of the educational dimensions. Hence it must be concluded that the structural differentiation aspects of educational systems are relatively independent of the other identified dimensions. Although data for 1960 only are used here, the obtained result is sufficient, in light of Farrell's other work, to add the structural differentiation dimension to the list of basic educational indicators to make a core of 10.

There is no major published research project directed towards the formation of educational indicators in the areas of input preferences or the two output categories. Certainly some of the IEA studies across a number of countries might form a basis for indicator development. So too might some of the results of projects such as that being conducted at Syracuse (Nickse, 1975) or the National Assessment Project in the USA. Mushkin (1973, p. 25) envisages such a development from the latter project as being possible. At this time however nothing has been forthcoming.

This review of the literature reveals that little empirical work has so far been done on forming composite indicators of educational system performance. Other studies, such as those by the OECD (1971 and 1973) or by Carr-Hill (1973) could also be listed as having relevance to the area. They are excluded on the grounds of their non-empirical nature. It is one thing to suppose an indicator is effective but quite another to demonstrate that it is. Also excluded as studies dealing with the representative indicators (e.g. Duncan, 1968 and King, 1972) and composite indicators developed for specific and local purposes (e.g. Little and Mabey, 1972).

Table 3. Rank-order correlation coefficients between the structural differentiation dimension and the 1960 process educational dimensions

1960 Process Dimension No.	Rank-order Correlation
1	0.098
2	0.242
3	0.189
4	-0.041
5	-0.106
6	-0.318
7	0.166
8	0.075
9	-0.268
10	-0.148

One non-empirical study could be mentioned in depth however - that by Unesco (1974b). It attempts to present "a synthesis of pre-selected data. . . (which are) highly selective and aggregative; they . . . telescope various information inputs into a simple 'dashboard' signal. Their use in diagnosis aims at revealing imbalances and is comparable to that of a primary medical check" (I/1). A framework consisting of three parts - inputs, internal process and output - is proposed although no definition of the terms is provided. Also given is a list of variables for which data have been checked as being available in many developing countries. From this list a set of 13 composite indicators is formed.

A typical indicator is that to show differences in educational flows between boys (M) and girls (F) (IV/5):

$$I = \frac{(a.\,b.\,c.\,d.)^F}{(a.\,b.\,c.\,d.)^M}$$

where a = first time, first grade enrolment ratio
b = first level education completion rate
c = rate of progression to second level education
d = second level education completion rate

Each indicator 1/ is transformed so that its range of values extends from 0.0 to 1.0 where higher values indicate a 'better' educational situation. Also defined is a 'red zone' value. If an indicator value is calculated for a particular country and it falls within this zone, a 'major dysfunction' is considered to be revealed which should be a focus for immediate planning action. For the above indicator, for example, the zone is defined as extending from 0.0 to 0.6. Thus if the flow of males through a system exceeds the flow of females (or vice-versa) by the ratio 6 to 10 or less, an undesirable situation is indicated.

There are three major criticisms of the Unesco work although it does represent the most advanced development of composite indicators so far by any of the international organizations concerned with educational systems. The first criticism is that the development of the indicators lacks a sound conceptual base. Although a division of the total space is suggested, this is not seriously pursued. For example, the above cited indicator consists of a mixture of both 'input' and 'internal process' variables. In a somewhat different vein, some indicators combine values for male and female variables while in other indicators, such variables are reported separately for the sexes. No justification is given for the difference in concept. As has been discussed earlier, varied composition of the indicators - particularly of that type cited in the former of the two examples - makes interpretation difficult and is thus most undesirable.

The second criticism is that no explanation or reason is advanced for the methods of combining variables into the composite indicators. Sometimes addition is used; as other times multiplication (and division) is used. However without a rationale as to when a particular method should be used or a justification of the implication of equal weights throughout, the validity of the indicators must be seriously questioned on statistical grounds alone.

1/ If the value for the numerator exceeds that for the denominator of the indicator defined above, the reciprocal value of that formula is calculated.

The third criticism is that no empirical test of the indicators is made - not even to show that they do succeed in a few selected countries. Their educational validity must be established if they are to be used in field work as is envisaged. However, this criticism can be easily overcome if Unesco, the World Bank or individual researchers were to collect data and investigate the effectiveness and efficiency of the set of suggested indicators. Such efforts should be forthcoming soon.

One further source can be analysed to gain confirmation of existing patterns. Although not directly concerned with forming educational indicators, a number of studies analyse a range of variables of different types. Some of these (e. g. Adelman and Morris, 1967; Russett et al, 1964; Rummel, 1972; and Unesco 1974a) either do not contain enough variables relating directly to education or else confirm the existence of the expansiveness input dimension in the same way as did the Harbison and Myers' composite indicator.

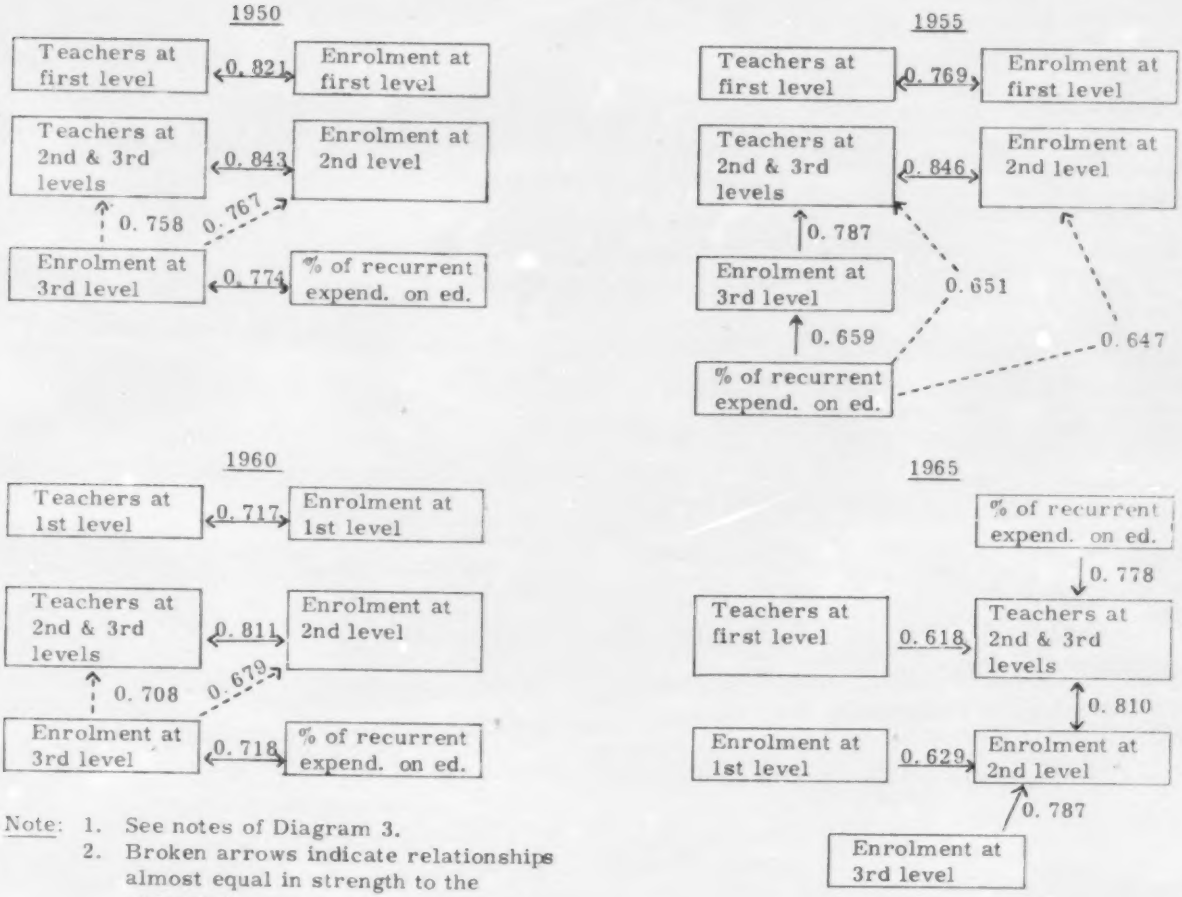
Two studies which do report correlations on a range of educational variables are Harbison et al (1970) and McGranahan et al (1972). The former report data for 1950, 1955, 1960 and 1965 across a number of countries while the latter report data only for 1960. Diagrams 4 and 5 summarise the crude clustering results. Unfortunately the Harbison tables (pp. 120-121 and 128-129) only relate to input variables; inter-correlations between the defined process variables are not reported. Each of the patterns in the two diagrams confirms the nature of the input expansiveness dimension. Again the uncertain pattern of inter-relationship of the financial variable can be noted and from this behaviour can be inferred (perhaps post hoc) the possible existence of a separate financial input dimension. The McGranahan results also support the input expansiveness dimension. The relative independence of the two process variables also lends some support to the need for two indicators separately involving these variables (e. g. the dimensions numbered 3 and 7 on page 23).

Further empirical work directed to the construction of indicators of educational system performance should and must be undertaken soon. Until further results are forthcoming therefore, the nine indicators listed earlier plus the structural differentiation dimension will have to be used. These ten indicators are listed again in Table 4.

Table 4. Summary of the set of basic educational indicators

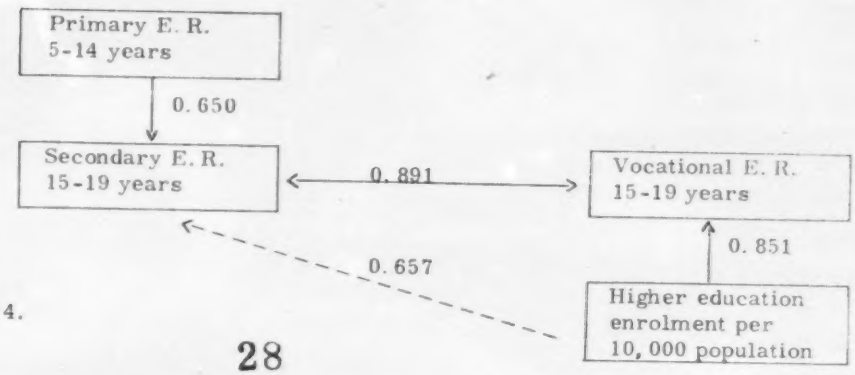
1.	Expansiveness of involvement in educational provision.
2.	Development emphasis placed by a country in increasing the involvement of students in education.
3.	Financial commitment of a country to providing formal education and the extent of present development emphasis.
4.	Extent and refinement of basic education.
5.	Extent of involvement of females in education.
6.	Present extent of pre-school provision.
7.	Present extent of second level general education.
8.	Extensiveness of the development of third level education.
9.	Orientation of courses studied by students at the third level.
10.	Extent of the structural differentiation of the educational system.

Diagram 4. Summary results of crude clustering on Harbison et al correlation matrices



Note: 1. See notes of Diagram 3.
2. Broken arrows indicate relationships almost equal in strength to the strongest.

Diagram 5. Summary results of crude clustering on McGranahan et al correlation matrices



Note: See Diagrams 3 and 4.

VIII. FURTHER DEVELOPMENT OF THE IDENTIFIED EDUCATIONAL INDICATORS

Further development of the ten empirically identified dimensions is now required to enable them to be used as indicators in more general situations. Little further can be done to refine Farrell's index as it is only really effective for the developing countries. Discussion will thus be aimed at refining indicators 1 to 9 in Table 4. As these dimensions were developed, they apply only to a certain number of countries for the years 1960 and 1969. They also involve the estimation of many values which are peripheral to the definition of each indicator.

To define each educational indicator, those variables which were significant in both 1960 and 1969 in defining the educational dimensions are selected. In almost all cases, there is no ambivalence in selecting these, but where there is, the removal or retention of the single variable in question can be decided on logical grounds. The 1960 process dimension 4, for example, contains four variables to indicate the orientation of students studying at the third level while the corresponding 1969 process dimension 4 contains seven variables - four of which are common to the 1960 dimension. In this case, the four in common are chosen. The variables selected in this way for each of the nine indicators are listed in Appendix II. Also listed there are other statistics to be used for calculating indicator values especially during the period 1960-1969. Each variable, for example, has a recommended weight to be used in forming the composite indicator value. These weights are calculated by averaging the 1960 and 1969 factor loadings. Continuing the third level study orientation example, the weights for each of the four variables common to both the 1960 and 1969 process analysis dimensions are calculated from the data in Appendix I as follows:

% 3 M HEF	:	(-0.49 - 0.80)/2	= -0.65
% 3 F HEF	:	(-0.68 - 0.74)/2	= -0.71
% 3 M LSS	:	(0.62 + 0.80)/2	= 0.71
% 3 F LSS	:	(0.75 + 0.86)/2	= 0.81

In defining three of the indicators, it is possible to define sub-indicators as well. The calculation of values for these can sometimes help to explain the value of an overall composite indicator more precisely. For example, input indicator 3 - relating to the financial commitment and emphasis can be subdivided into one sub-indicator dealing with the relative level of expenditure within a country and a second sub-indicator dealing with the rate at which that level is changing. The use of each sub-indicator separately describes these two separate aspects while their amalgamation gives an overall picture of the financial commitment and emphasis of a country.

A distinction in the kinds of features to be measured by indicators needs to be made before proceeding further. This distinguishes, in all of the five theoretical areas of an educational system, between indicators referring only to levels of educational provision and indicators referring to the uniformity or diversity of that aspect throughout a country. Indicators reflecting the former consideration are referred to as 'non-distributive indicators' and those reflecting the latter consideration as 'distributive indicators'.

An example clarifies the distinction being made. Suppose that (despite its weaknesses) a representative indicator of the construct of educational involvement is to be used to distinguish among

a group of nations. The first level enrolment ratio is the variable selected. The overall or mean values of the enrolment ratio for three selected nations 1/ are :

Nation A : Enrolment ratio = 70

Nation B : Enrolment ratio = 70

Nation C : Enrolment ratio = 80

Now suppose that first level enrolment ratios within educational regions of each country are calculated. The variability within countries across these regions is reflected by the standard deviations which may be as follows:

Nation A : Standard deviation = 20

Nation B : Standard deviation = 5

Nation C : Standard deviation = 15

Although Nation A and B have the same mean (non-distributive indicator) value, an indicator merely showing this value and not accounting for the difference in variability within a country hides the difference in equality of access to education in the two countries. Similarly, although differences between Nation A and Nation C appear significant when considering only the mean values, the large standard deviations reduce the educational significance of the 10 point difference quite substantially. Generally non-distributive indicators are used and hence methods to estimate these are discussed in detail below. Distributive indicators are much more difficult to calculate and, because data are generally lacking for their estimation at this time, only outlines of possible approaches that might be used can be provided here.

1. Non-distributive educational indicators

Two indicators of the non-distributive type are proposed. One of these indicators can be regarded as being formed in the manner of Lazarsfield and Barton's 'functional reduction' approach - the other being approximately situated somewhere between this and the 'arbitrary numerical reduction' approach. Probably they are both 'guided numerical reductions'.

The first form of composite indicator proposed is akin in nature to the dimensions themselves. It involves the calculation of standardised scores. 2/ Hence this typed indicator estimates the position of each country across a number of variables relative to the positions occupied by all countries. To calculate the value for this 'standardised educational indicator', the weightings for each component variable of the indicator must be known as well as the mean and standard deviation values calculated across all countries.

An example demonstrates what is involved in calculating this form of indicator. Assume that the process indicator 'the extent of female involvement in education' is to be estimated for a number of countries across a three-year period. The variables defining the female involvement indicator as chosen earlier are listed in Appendix II together with the recommended weighty values for each variable.

1/ Although three nations have been used as the example, the same conclusion applies as if the data related to the one nation at three different points in time (say Year A, Year B and Year C).

2/ For a discussion of standardised scores see Cronbach (1970, pp. 94-97) and Ebel (1972, pp. 484-488).

These values 1/ are used in forming the indicator as follows:

$$I = \frac{1}{3.9}(0.67z_1 + 0.81z_2 + 0.75z_3 + 0.83z_4 + 0.84z_5)$$

where I = indicator of female involvement in education

$$z_i = \frac{X_{ij} - \bar{X}}{S_i}$$

= standardised score for a country on the ith variable which has a world mean of $\bar{X}_i$ and standard deviation S_i

The multiplier '$\frac{1}{3.9}$' is the reciprocal of the sum of the weights and is merely used to transform the units back to the usual standardised score values for ease of interpretation.

Standardised educational indicators are calculated on interval scales and hence inter-country comparisons of changes across different parts of the scale can be compared. Changes of less than 0.2 or so in magnitude are not really significant in the educational sense but changes in indicator value of 0.5 or more certainly reflect a significant redistribution has occurred within that part of the educational system being represented. The range of possible indicator values is also fairly clearly defined - values less than -2.5 or greater than +2.5 are uncommon. Comparison of values on different indicators is also possible.

To demonstrate the calculation of indicator values, female involvement levels in Australia are estimated. (Means and standard deviations are also reported in Appendix II for all variables defining the indicators.) Table 5 shows the Australian raw data for each variable for 1968, 1969 and 1970 as well as the corresponding z score and the total indicator value for each of the years.

If Australia had a female participation level across all variables entering the calculation equal to world average, the value for this indicator would be 0.0. If Australia's level were lower than average, the value would be negative. As it appears, the participation levels are significantly above world averages - thus indicating that, taken collectively over pupils at all levels and teachers at the first two levels, the involvement of females in Australian education is comparatively high and stable over the period. This conclusion does not say that participation is approaching a maximum

1/ As the average factor loadings on this indicator, as well as on some of the other indicators reported in Appendix II, are reasonably similar in value, they might be equated so that each variable contributes equally in calculating the value for an indicator. However, for standardised indicators, the empirical differences in weights should be preserved both because of the observed differential importance of the variables and because this type of indicator is defined as being precise in nature.

Table 5. Example of standardised indicator calculation - Australia (female involvement)

Year	Score	%F-P1	%F-P2	%F-P3	%F-T1	%F-T2	I
1968	Raw	48	48	30	68	48	0.530
	z	0.478	0.678	0.062	0.577	0.799	
1969	Raw	48	48	32	63	46	0.485
	z	0.478	0.678	0.220	0.372	0.653	
1970	Raw	48	48	33	65	47	0.520
	z	0.478	0.678	0.230	0.454	0.726	
Weighty factor		0.67	0.81	0.75	0.83	0.84	

or ideal value nor that it is 'good' or 'bad' to have high female participation in education. The comparison being made with other countries merely places Australia relative to the remainder for the year 1969.

In this calculation, an assumption is made that over the 1968-1970 period, no change occurred in world patterns in female involvement. This assumption thus allows the use of the 1969 mean and standard deviation values for the other two years. Although some change probably did occur, it is considered that the values calculated here are reasonably approximate to the actual values so no large error has been introduced. The tenability of this constancy assumption would be extremely dubious for other variables or for longer time periods. Ideally what is required for the calculation of standardised educational indicators is the reporting of the values of descriptive statistics by agencies like Unesco in their annual data tabulations. Certainly with some distributions (first level enrolment ratio is one in particular) severe skew distorts the values of each of the basic statistics but then more appropriate descriptive values could certainly be calculated.

Table 6 presents a comparison of indicator values for two different time periods across countries shown to be dissimilar overall in the process aspects of their educational systems (Johnstone, 1974, pp. 187-193). World values for the year 1960 are used to estimate the 1960 standardised indicator values. The table shows that for each year, Israel has very extensive involvement of females in education compared to other countries and her relative position in this respect has increased markedly over the 1960 decade. The high negative values for Iran show that, comparatively, fewer females are involved. However, Iran shows a considerable positive change in its standardised indicator values reflecting a desire on the part of the government and/or Iranians to increase the female participation rates in education. This is not the case in the Netherlands where female involvement was very slightly below world average in 1960 and it seems to have remained at that relative point until at least 1970. El Salvador appears to have made slightly greater improvement in involving females in education than most other countries - changing its indicator value from being slightly negative to slightly positive.

Table 6. Values for standardised indicator on female involvement in education - 5 selected countries

Country	Indicator value for year			
	1960	1968	1969	1970
Australia	0.064	0.530	0.485	0.520
El Salvador	-0.072	0.139	0.044	0.095
Netherlands	-0.150	-0.097	-0.091	-0.146
Iran	-1.472	-0.599	-0.594	-0.644
Israel	0.323	0.836	0.860	-

Note: Sufficient data are not available at the time of writing to allow the calculation of a 1970 value for Israel.

The values for other standardised educational indicators are not calculated here. The defining variables for each indicator, their loadings and the 1960 and 1969 world means and standard deviations are listed in Appendix II. Hence values can be calculated for particular countries as required.

Such an approach as described here is a compromise between sheer empiricism and required pragmatism. It is a guided adaptation of empirically demonstrated and stable results and is a method requiring simple yet minimal calculation. Its values are easily interpreted. Of the two methods to be proposed for non-distributive indicators, it is considered the better.

As used here, the standardised indicators have been calculated to relate to world patterns. The method can also be used on data relating to a selected group of countries. For example, if relative progress were to be mapped for countries within the Asian region only, standardised educational indicators could be calculated so as to relate to only those countries and not to all countries. A number of variations of this type are possible but will not be elaborated here.

Standardised indicators can be used either for inter-country or intra-country comparisons. If acceptable[1] values of the mean and standard deviations are easily available, then both types of analysis are facilitated. If the data are not available, the calculation of world average values for a number of years is an enormous undertaking merely to map the progress of a single country. Some other method such as that to be described below might then be more preferable although less accurate.

1/ What is meant by the term 'acceptable' could vary and the United Nations, Unesco or some other reporting agency would have to define the term. In calculating the 1969 values reported here, data available on all countries were used provided that those countries had gained their independence before 1960 and had relative political stability over the 1960-1969 period. These conditions attempted to ensure that values used in the calculations reflected the desire of governments within countries to provide education. This minimised a desire for education biased by frequent or violent changes of government or by financial or manpower support beyond a country's means because of its dependence on another country.

The second method for constructing educational indicators of the non-distributive type involves the use of index numbers. Such an approach is most useful for mapping educational progress over a given period - say that covered by a plan - within a single country. It can be generalised to cover a group of countries although many difficulties of interpretation can then arise. Limited cross-country comparisons are however possible.

The use of index numbers is most common in reporting changes in economic data. Generally a base number of 100 is chosen for the value of a variable in a particular year. The calculation of ratio values of data for other years compared to the base year thus gives a set of numbers varying around 100. Values less than 100 show that a decrease has occurred relative to the base year while higher values reveal an increase. As the essence of the method is reference to a particular point in time, the values for 'baseline educational indicators' are situation specific.

To demonstrate the calculation and interpretation of this form of indicator, the female involvement example is reworked for Australia, Iran and Israel - the three countries showing most change in Table 6. In each case, 1965 is taken as the base year. The indicator values are reported in Table 7. In the calculations here, all variables are equally weighted rather than use the more accurate weighty procedure as used previously. Such approximation is made because the inherent crudeness of the index numbers would mock such artificial accuracy. It may be claimed that because a plan for a particular country does not give equal weight to all areas, it is unfair to use equal weights across all variables in forming an indicator. Those areas that have been expanded or which are targets for action, it could be argued, should be weighted more heavily. Certainly if planners and administrators, who use indicators, feel strongly in this way, differential weights can be given to different variables. As far as baseline indicators are concerned, the use of such procedures is merely playing games with statistics. An overall objective indication is required of the particular feature in that country - whether that indication be favourable or not. Such objectivity should not be destroyed by attempting to ensure that a sector which has been recently developed is weighted more heavily.

The range of comparison within a country is broader than in the example for the standardised indicator because the baseline indicators do not require data beyond an individual country. Indeed

Table 7. Values for baseline indicator on female involvement in education - 3 selected countries

	Countries		
	Australia	Iran	Israel
1960	87.1	85.0	89.6
1964	97.8	-	96.5
1965	100.0	100.0	100.0
1966	97.5	102.1	97.6
1967	96.8	105.3	103.1
1968	97.8	109.4	103.7
1969	96.7	109.1	104.6
1970	98.3	107.5	-

Table 7 could report indicator values throughout the entire 1960 decade as well as before and after. The choice of 1965 as the baseline year is entirely arbitrary and either 1960 or 1970 could have equally well been selected. Then, of course, the numbers reported would be different although the information conveyed as to the trends followed would be the same. 1/

The values show the same trend as did the values in Table 6. The essential difference between the two sets however is that values between countries cannot be equated. No implication can be made that the three countries had, in 1965, the same levels of female involvement in education. The only inter-country comparison possible is to conclude that relatively, Iran had improved its position by 1969 more than had Israel, while in Australia, females had slightly less relative involvement in 1969 than they had in 1965. Indeed, 1965 marked a peak in their involvement pattern. 2/

The choice of one rather than the other of these two indicators depends very much on the use intended for them. Both types can assist in all of the three purposes for indicators discussed earlier.

In change monitoring, standardised indicators partial out the effect of changes occurring in other countries. Taking over the broad international spectrum, such changes can be regarded in some ways as being evolutionary developments. Although this does not imply that changes will occur despite planners and administrators, it does acknowledge the inter-connectedness of nations. Standardised indicators have as their strength the property that they reflect changes beyond these more natural or inter-connected changes. This is of great importance in developing countries particularly where planners and policy-makers need to know whether their efforts are really having a significant impact on the development pattern of their country. Baseline indicators do not reflect such relative changes. Certainly a small number of countries can be compared as in Table 7 but no indication can be easily obtained on relationships across a large number of countries. The baseline indicator is more useful for monitoring those changes within a country attributable to the implementation of policies within the framework of a plan.

For the second way in which indicators can be used - for assisting in the planning process - baseline indicators are more useful. In quantifying goals, planners and policy-makers can establish targets in terms of values for the present year or the first year of a plan. It is more realistic to establish such goals without regard to movements which may or may not occur in world patterns. The needs and demands within a country are the most important effects to be measured. Previous trends in standardised indicators could be considered as well and planners could establish targets which ensured that a country did not fall below world trends during a planned period. This is

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1/ Hoover (1968) discusses the problems of using index numbers and makes special note of the difficulties in choosing a base year.

2/ For the years 1968, 1969 and 1970, Table 6 shows greatest involvement which occurred in Australia in 1968, while Table 7 shows the same but which occurred in 1970. Although the differences in values are slight and certainly not educationally meaningful, they have occurred because of the differential weightings of variables used in calculating values for Table 6.

unlikely to occur in areas forming a main focus of a plan but it could occur in areas not explicitly considered. However, as policy-makers must be primarily concerned with their own country situation, baseline indicators are the more appropriate type of non-distributive indicator for use in planning.

For research purposes, no conclusion can be made as to the possible effectiveness of either type of indicator. The standardised indicator appeals as being intuitively better and it has been used to form quite significant hypotheses about patterns of educational provision (Johnstone, 1974 and 1976b). Any selection between the two types, however, must be framed with a particular hypothesis and situation in mind. For some hypotheses and situations, the baseline indicator will be better. Both types therefore are probably equally as valuable.

A feature possessed by both types of indicator is that they measure educational systems performance in relative rather than in absolute values. Measuring absolute quantities of gross enrolments, total budgetary allocations, etc. is of little practical use in cross-national studies or for monitoring change within a country. Certainly for some planning purposes it is necessary to know or to estimate how many teachers are required and how many additional classrooms need to be erected. Such measurements form the bulk of most statistical reporting schemes such as, for example, the annual Unesco Statistical Yearbook and Ministers' Reports. However using absolute values in indicators for inter-country comparisons shows countries such as the People's Republic of China, the USSR, the USA and India, as having the biggest or the best educational systems. Certainly they have the biggest in terms of gross totals but the information conveyed about the systems relative to their environment and the resources they might take portrays a very different picture. Removing the effect of the environment by using indicators which have partialled out the resource potential allows a country as small as Norway to be shown as being more advanced educationally than at least two of the four countries mentioned above. Inputs are defined as they are on page 11 for this very reason. Process variables are based on a similar concept.

Even with this definition of variables, indicators might still be formed by adding together the values of the variables defining an indicator. This is what Harbison and Myers basically do when they combine second and third level enrolment ratios to form their composite index discussed earlier. A 1970 female involvement indicator value for Australia, for example, could be calculated as 241 and compared to the 1969 value of 237. Some interpretation might be attempted of the difference between these values if such an exercise were not so absurd. Not only are the values meaningless and incomparable but the differences in variances of the cross-country distributions for each variable make interpretation supererogotory.

2. Distributive educational indicators

The second type of educational indicator which can be developed - the distributive educational indicator - reflects the distribution of particular educational features throughout a country. This type of indicator is thus not concerned with the level of those features as are the non-distributive features but with questions of equality. Such indicators reflect, for example, the differences in female participation rates between various regions within a country or the distribution of achievement levels in particular subject areas.

Distributive indicators are particularly useful in the three areas of the theoretical model not represented in the basic indicator set. They do also have some usefulness in highlighting inequality considerations in some of the ten indicators developed here. However almost all examples which might now be developed are prevented from so being because of data limitations. Broad guidelines only can therefore be outlined and a hope expressed that research projects may soon be undertaken to provide data and so test the validity of the following proposals. Certainly no suggestions can be made here concerning which variables might be combined to form composite indicators. Instead discussion is restricted to methodological considerations.

To indicate variation - or inequality - in test scores, a number of measures have previously been used. These are generally variations on either the standard deviation statistic or the score indicating a particular percentile rank. For the latter measure, for example, some of the IEA studies use the score obtained by students within a country at either the 91st or the 99th percentile for inter-country comparisons. (See, for example, Husén, 1965.) These techniques are well known and need no elaboration. They are generally not applicable for indicator development however both because they are scale dependent and because of the incorrectness of adding raw scores (or standard deviations) together as would be done in forming a composite indicator.

Another approach to estimating variation is to use some form of mathematical model. Two such models are involved in estimating the Pareto α and the Gini δ coefficients in the study of the equality of income distributions. Other models also could be mentioned. However the dependence of fitting a theoretical model to a particular data set and the extent of its lack of fit can severely distort results (as occurs with Cline, 1972, p. 109). Thus this general approach also seems to offer little hope for the development of distributive educational indicators.

A third approach which may offer promise involves the calculation of Lorenz curves and the estimation of the derived Gini concentration ratio G. The Lorenz curve, as originally developed, plots the cumulative percentage of an aggregate quantity (such as income) against the cumulative percentage of units receiving or providing that quantity. When every unit has the same quantity - for example, all people have the same income or all firms have the same output - the Lorenz curve is a straight line. As inequality increases and income or output is progressively more unevenly distributed, a more hyperbolic curve is attained. Diagram 6 shows three Lorenz curves at varying levels of inequality.

A suitable measure of the inequality existing in a particular situation, and that measured by the Gini G coefficient, is the ratio of the area between the curve and the diagonal to the total area under the diagonal. 1/ When a perfectly equal distribution is obtained, G equals 0.0; when an unequal distribution is obtained, G equals 1.0. As G is scale-independent, estimates from a number of

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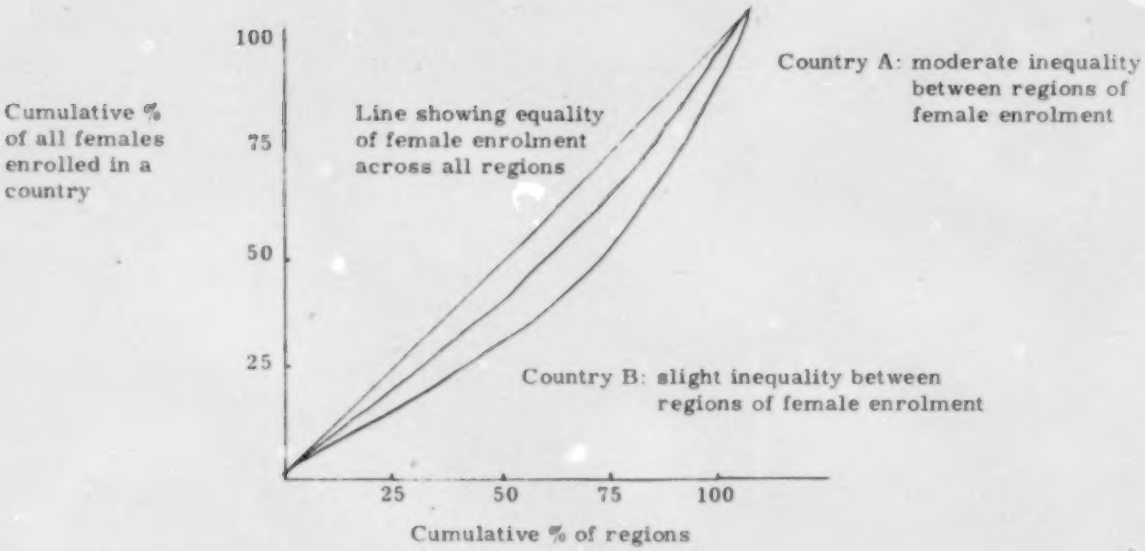
1/ The value for the coefficient can be calculated by the formula

$$G = 1 - 2\left[\sum_{i=1}^{n} (w_i - w_{i-1})\, z_{i-1} + \frac{1}{2}\sum_{i=1}^{n} (w_i - w_{i-1})(z_i - z_{i-1})\right]$$

where w_i = ith observation on the cumulative fraction of the recipients
z_i = ith observation on the cumulative fraction of the aggregate quantity and the nth observation is the point (1, 1).

Diagram 6. Lorenz curves for two countries showing equality between regions of total female enrolments



specific variables can be combined into a composite and then this composite meaningfully interpreted. Both Bowman (1951) and Cline (1972) find the Lorenz curve and the Gini G coefficient superior to other methods, of estimating inequality. Bowman concludes: "The Lorenz curve ... is a fairly sensitive indicator of inequality in so far as disparities may legitimately be weighted in terms of arithmetic differences."(p. 99) It thus appears that the Lorenz curve and the derived Gini G coefficient hold promise for the development of certain distributive educational indicators. Research in this area must therefore be undertaken to investigate if this is so.

A final approach to estimating values for educational indicators from variables reflecting the distribution of a quantity in a population is to use the Rasch model. Although this is a mathematical model requiring certain conditions to be met, it is fairly robust and has been used for both test and survey purposes (see Wright, 1968; Lindsay, 1973 and Willmott and Fowles, 1974). This model attempts to provide an objective basis for data interpretation by removing the effects of both the sample used as well as the questions asked. It is thus ideal for developing indicators for cross-national comparisons. As data again prevent its being developed here for use, further discussion must be curtailed. The Rasch model does however merit great consideration by those involved with the IEA studies or with the National Assessment project in the USA.

IX. DIRECTIONS FOR FURTHER INDICATOR RESEARCH

This outline of composite indicators describing the performance of educational systems is necessarily incomplete. Further research, refinement and additions must be made if the potential of indicators of educational system performance are to be realised.

One area with which research should be concerned is that of extending the indicator sets as developed. As the percentage of variance for the respective dimensions originally extracted shows, there are still unidentified ways in which educational systems differ. These should be investigated with a view to adding new indicators into the indicator set developed here. Ways in which such research might be conducted are outlined elsewhere (see Johnstone, 1974, pp. 243-244).

Research should also aim at extending the indicator set into sub-national levels. The indicators as developed here are purposefully directed to representing the national or syntal characteristics of educational systems and this focus has three main implications. Two of these - the effect of errors in the recording of data from such a broad base and problems in interpreting obtained values - are dealt with elsewhere (see, for example, Rummel, 1970; Russett, 1965 and Allardt, 1966). A third implication which does need elaboration here is that the indices developed do not necessarily apply to the description of educational systems performance at the regional or local level. Some writers see the inability of national indicators to describe events at a local level as an inherent weakness and one that places national indicators in the 'of great limited usefulness' category. Anderson reflects this attitude when, in reviewing Baster's Measuring development: the role and adequacy of development indicators, he politely writes: "I would think that the most recalcitrant problems of development call for micro-analysis; yet Baster's proclamation would appear to give central place mainly or solely to aggregate decisions" (1975, p. 773). National aggregation is sometimes required as is local aggregation. It is impossible to answer all questions with a single set. Taking the implication of this statement to the extreme, it is even impossible to develop a set of 'indicators' with which to describe a single individual. Characteristics such as height, weight, skin, eye and hair colour, mental and physical ability, interests, etc. give an impression of what a person looks like and what he can do. Such a set cannot be used adequately to describe a large number of 'similar' or 'different' people nor can it describe completely that one individual for all purposes. Some characteristics important in specific situations are certain to be omitted. It is the same with national educational indicators. They can only convey the impression of what is happening within the educational sector of a country. Unfortunately proper indicators of education at sub-national levels are not available at present. Research studies should be undertaken therefore to develop such indicators along the lines suggested here. When their results are forthcoming, reliable and valid indicator sets for particular purposes will be available for use in monitoring change, planning and research across a broad range.

A third direction research might pursue is the development of procedures to determine the effectiveness and efficiency of educational indices. Some idea of these properties can be gauged by the amount of variance extracted by the original factor analysis - but this is a most indirect inference. Malizia (1972) has begun work in this area but a coherent programme needs to be undertaken. Perhaps this programme should start with investigating the effectiveness and efficiency of the indicators proposed here. If the reliability and validity of indicators are not assessed or assessable, there is a danger that we will measure 'something not meant against something not intended'.

X. CONCLUSION

Indicators of educational system performance have importance for various purposes in monitoring the development of educational systems. They should be composite in form and allow a quick review of the state of the system, especially of the most important areas. The set of indicators suggested here could form the basis of a common set used in the monitoring and analysis of educational systems. Further research is indicated as being immediately required. If this is undertaken, then an internationally proven and accepted educational evaluation device will be brought closer to realisation. The complexity, the expansiveness and the cost of educational systems designate this as a priority area for urgent attention.

Appendix I

SUMMARY OF DIMENSIONS EXTRACTED FOR EDUCATIONAL SYSTEMS

To provide a reasonably complete account of the dimensions and the variables from which they are extracted, this Appendix lists all variables used, their interpretations and the significant factor loadings. Explanations as to why particular variables are included while others are excluded plus a discussion of the errors likely to arise in the variables, see Johnstone (1974, pp. 248-296).

Table I. The input variables - their interpretations and codes

No.	Variable	Interpretation of variable	Variable Code
1.	Adjusted first-level enrolment ratio - males	Indicates the extent of involvement in education of those in age-groups of the population eligible to enrol in a particular level	1 ER - M
2.	Adjusted first-level enrolment ratio - females		1 ER - F
3.	Adjusted second-level enrolment ratio - males		2 ER - M
4.	Adjusted second-level enrolment ratio - females		2 ER - F
5.	Number of third-level students per 10,000 population		3 STUD
6.	Percentage of students at the third level from foreign countries	Indicates provision made for third-level study by students from other countries	% FOR
7.-11.	Rate of change in variables 1-5	Indicates changing rate of involvement in education by the population eligible to enrol in a particular level	ROC precedes appropriate variable code above
12.	Rate of change in variable 6	Indicates changing provision for third-level study by students from other countries	
13.	Teachers per 10,000 population	Indicates extent of involvement in and responsibility for the provision of education by a population	TEACH
14.	Rate of change in variable 13	Indicates changing involvement patterns and responsibilities by a population in providing education	ROC TEACH
15.	Total amount spent on education as a proportion of Gross National Product	Indicates a relative financial involvement of a country in providing education	% GNP
16.	Public educational expenditure as a percentage of total government expenditure		% BUD
17.	Rate of change in variable 15	Indicates change in the financial involvement of a country in providing education	ROC % GNP
18.	Rate of change in variable 16		ROC % BUD

Table II(a). Orthogonally rotated factor matrix of 1969 input variables

Variable	Factor 1	Factor 2	Factor 3
1 ER-M	0.86	0.10	0.06
1 ER-F	0.92	-0.06	0.07
2 ER-M	0.70	-0.40	-0.10
2 ER-F*	0.86	-0.39	-0.03
3 STUD*	0.77	-0.34	-0.01
TEACH	0.80	-0.35	-0.05
% GNP	0.37	-0.37	0.56
% BUD	0.05	-0.03	0.46
ROC 1 ER-M	-0.21	0.80	0.11
ROC 1 ER-F	-0.22	0.84	-0.01
ROC 2 ER-M	-0.61	0.29	-0.01
ROC 2 ER-F	-0.56	0.33	0.17
ROC 3 STUD	-0.41	0.16	0.00
ROC TEACH	-0.27	0.36	0.03
ROC % GNP	-0.13	0.09	0.58
ROC % BUD	-0.10	0.17	0.67
% OF TOTAL VARIANCE	32.60	15.20	8.60
% OF COMMON VARIANCE	57.90	27.00	15.20

* Variable transformed using $\log_{10}(X+1)$ transformation.

Table II(b). Orthogonally rotated factor matrix of 1960 input variables

	Factor 1	Factor 2
1 ER-M	0.79	-0.21
1 ER-F	0.81	-0.39
2 ER-M	0.84	-0.10
2 ER-F*	0.93	-0.25
3 STUD *	0.78	-0.22
TEACH	0.85	-0.24
% GNP	0.72	0.13
ROC 1 ER-M	-0.42	0.78
ROC 1 ER-F	-0.56	0.68
ROC 2 ER-M	-0.03	0.50
ROC 2 ER-F	0.06	0.45
ROC 3 STUD	-0.27	0.48
% OF TOTAL VARIANCE	43.90	17.90
% OF COMMON VARIANCE	71.00	29.00

* Variable transformed using square root transformation.

Table III. The process variables - their interpretations and codes

	Variable	Interpretation of Variable	Variable Code
1.	Ratio of male enrolments at the pre-school level to male enrolments at the first level	Indicates relative size of vertical divisions on separate sides of the educational pyramid of a country	P/1M
2.	Ratio of male enrolments at the second level to male enrolments at the first level		2/1M
3.	Ratio of male enrolments at the third level to male enrolments at the second level		3/1M
4.	Ratio of female enrolments at the pre-school level to female enrolments at the first level		P/1F
5.	Ratio of female enrolments at the second level to female enrolments at the first level		2/1F
6.	Ratio of female enrolments at the third level to female enrolments at the second level		3/2 F
7.	Ratio of enrolments in special education to enrolments at the first level	Indicates extent of provision of special education facilities	SPEC /1
8.	% of first level enrolment who are female	Indicates relative size of horizontal divisions on each side of the educational pyramid of a country	% F-P1
9.	% of second level enrolment who are female		% F-P2
10.	% of third level enrolment who are female		% F-P3
11.	Proportion of all second level male enrolments in the general education stream	Reflects relative emphasis between streams at the second level of education within a country	% 2 M GN
12.	Proportion of all second level female enrolments in the general education stream		% 2 F GN
13.	Proportion of all second level male enrolments in the teaching training stream		% 2 M TT
14.	Proportion of all second level female enrolments in the teacher training stream		% 2 F TT
15.	Proportion of all third level male enrolments following Humanities-Education-Fine Arts courses	Reflects relative emphasis between streams at the third level of education within a country	% 3 M HEF
16.	Proportion of all third level female enrolments following Humanities-Education-Fine Arts courses		% 3 F HEF
17.	Proportion of all third level male enrolments following Law-Social Science courses		% 3 M LSS
18.	Proportion of all third level female enrolments following Law-Social Science courses		% 3 F LSS
19.	Proportion of all third level male enrolments following Natural Science courses		% 3 M NS
20.	Proportion of all third level female enrolments following Natural Science courses		% 3 F NS

Table III. (continued)

	Variable	Interpretation of Variable	Variable Code
21.	Number of student places provided at the third level per student studying at the third level in another country	Reflects extent to which social demand for third level education is met by a country's own educational provision	HOME/ABD 3
22.	Proportion of total first level enrolment in first two grades compared to expected	Reflects distribution of enrolments across grades and effects of early drop-out or repetition	ACT/EXP 1
23-29.	Rate of change in variables 1-7	Indicates relative emphasis in expanding enrolments at different levels of the educational pyramid in a country	ROC precedes the appropriate variable code listed above
30-32.	Rate of change in variables 8-10	Indicates rate at which provision for females (and thus indirectly for males) is changing	
33-42.	Rate of change in variables 11-20	Indicates changing emphasis of enrolments in the various streams at second and third levels	
43.	Rate of change in variable 21	Reflects attempt at accommodating the demand for third level education within a country	
44.	Rate of change in variable 22	Reflects changing distribution of enrolments at the first level	
45.	Proportion of teachers at the first level who are female	Indicates the relative responsibility between the sexes for educational instruction	% F-T1
46.	Proportion of teachers at the second level who are female		% F-T2
47.	Pupil-teacher ratio at first level	Reflects relative provision of teaching personnel per pupil enrolled	P-T1
48.	Pupil-teacher ratio at second level		P-T2
49.	Pupil-teacher ratio at third level		P-T3
50-51.	Rate of change in variables 45-46	Indicates relative change in responsibility for instruction between the sexes of the teachers	ROC precedes the variable code listed above
52-54.	Rate of change in variables 47-49	Reflects difference in rates at which teachers can be trained and/or recruited, compared to social demand for a particular form of education	
55.	% of total recurrent expenditure spent at the first level	Indicates relative part of total recurrent budget taken by each level	% $1
56.	% of total recurrent expenditure spent at the second level		% $2
57.	% of total recurrent expenditure spent at the third level		% $3
58.	% of total finance budget spent on capital expenditure	Indicates relative importance of building programme	% $ CAP
59.	% of total recurrent expenditure spent on teacher salaries	Indicates proportion of recurrent budget already committed for non-developmental activity	% $ T SAL
60-62.	Rate of change in variables 55-57	Indicates change in financial provision and thus relative emphasis placed between levels	ROC precedes the variable code listed above
63.	Rate of change in variable 58	Indicates change in emphasis on building programme over time	
64.	Rate of change in variable 59	Indicates change in proportion of recurrent budget which can be used for development purposes	

Table III. (continued)

	Variable	Interpretation of Variable	Variable Code
65.	Age of starting first level	Indicates main structural elements of educational system provision	AGE START
66.	Formal length of first level		LENGTH 1ST
67.	Formal length of second level general education stream		LENGTH 2ND
68.	Maximum number of years of compulsory education		YRS COMP
69.	Minimum number of years of general education prior to entering teacher training	Indicates relative level of education and training presently received by teachers	YRS BEF TT
70.	Level at which majority of teacher training is conducted		LEV MAJ TT
71.	Practice underlying certification at end of first level	Indicates certification practice at first level	EXAMS 1ST

Table IV. Summary of factor loadings of variables defining the 1969 process analysis factors

Factor	Variable	Loading
1	3/2 M	0.58
	3/2 F	0.51
	% F-P 1	0.78
	% F-P 2	0.88
	% F-P 3	0.69
	Home/abd 3	0.51
	ROC 2/1 M	-0.54
	ROC 2/1 F	-0.52
	% F-T 1	0.88
	% F-T 2	0.80
2	Pre/1 M	0.51
	2/1 M	0.91
	Pre/1 F	0.50
	2/1 F	0.88
	Spec/1	0.65
	% 2 M T T	-0.65
	% 2 F T T	-0.59
	Act/exp 1	-0.61
3	Pre/1 M	-0.57
	Pre/1 F	-0.59
	% 2 M gn	0.77
	% 2 F gn	0.81
	P-T 2	0.54
	P-T 3	0.53
4	% 3 M HEF	-0.49
	% 3 F HEF	-0.68
	% 3 M LSS	0.62
	% 3 F LSS	0.75
	ROC 2/1 F	0.52
	ROC P-T 2	0.58
	YRS BEF TT	-0.47
5	3/2 M	0.63
	3/2 F	0.70
	Length 1st	0.48
	Length 2nd	-0 84
	Lev maj TT	0.48
6	ROC 3/2 M	0.88
	ROC 3/2 F	0.62
	ROC % M 2 gn	0.49
	ROC % F 2 gn	0.61
	ROC Home/Abd	0.49
7	ROC Pre/1 M	0.89
	ROC Pre/1 F	0.89
	ROC % F-P 1	-0.55
8	ROC % F-P 3	0.80
	ROC % 3 F HEF	0.52
	% $1	-0.49
	% $3	0.59
9	ROC % 3 M HEF	0.50
	ROC % F-T 2	-0.62

Table IV. (continued)

Factor	% of total variance	% of common variance
1	12.4	19.2
2	10.3	16.1
3	7.6	11.8
4	7.1	11.1
5	6.6	10.2
6	5.6	8.7
7	5.2	8.2
8	5.1	7.9
9	4.4	6.9
TOTAL	64.3	100.0

Table V. Summary of factor loading of variables defining the 1960 process analysis factors

Factor	Variable	Loading
1	2/1 M	0.89
	2/1 F	0.85
	Spec/1	0.65
	% 2 M T T	-0.52
	% 2 F T T	-0.45
	Act/exp 1	-0.55
	% $ cap	0.48
	Length of 2nd	0.59
2	% F-P 1	0.55
	% F-P 2	0.73
	% F-P 3	0.80
	% F-T 1	0.78
	% F-T 2	0.88
3	ROC 2/1 M	0.83
	ROC 3/2 M	-0.87
	ROC 2/1 F	0.84
	ROC 3/2 F	-0.57
	ROC % 2 M T T	-0.71
4	% 3 M HEF	-0.80
	% 3 F HEF	-0.74
	% 3 M LSS	0.80
	% 3 F LSS	0.86
5	% F-P 1	-0.51
	ROC % F-P 1	0.79
	ROC % F-P 2	0.66
	ROC % 3 M LSS	0.85
6	% 2 M gn	0.91
	% 2 F gn	0.89
7	% 2 F T T	0.48
	ROC % 3 M HEF	0.83
	ROC % 3 F HEF	0.88
	P-T 2	-0.57
8	Pre/1 M	0.93
	Pre/2 F	0.95
9	Act/exp 1	-0.62
	Yrs bef T T	0.85
10	% 3 M N S	0.71
	% 3 F N S	0.85
11	Home/Abd 3	0.85
	% $ 1	-0.47
12	P-T 1	0.58

Table V. (continued)

Factor	% of total variance	% of common variance
1	11.5	13.6
2	10.0	11.9
3	9.2	10.9
4	8.5	10.1
5	7.9	9.4
6	6.9	8.2
7	6.7	7.9
8	6.4	7.6
9	5.3	6.3
10	5.3	6.3
11	3.8	4.5
12	2.8	3.3
TOTAL	84.3	100.0

Appendix II

VARIABLES DEFINING EDUCATIONAL INDICATORS AND ATTENDANT DATA FOR CALCULATION

Indicator	Defining variables	Recommended weights	1960 Mean[1/]	1960 Standard Deviation	1969 Mean[1/]	1969 Standard Deviation
1. Expansiveness of involvement in educational provision	1 ER-M	0.83	90.000	25.20	95.400	28.70
	1 ER-F	0.87	82.400	31.70	84.100	34.30
	2 ER-M	0.87	27.500	24.10	38.000	23.10
	2 ER-F	0.90	24.500	25.80	30.000	24.25
	3 STUD	0.78	35.600	34.50	57.000	28.50
	TEACH	0.83	65.200	29.50	78.400	41.10
	TOTAL WT[2]	5.08				
2. Development emphasis on increasing involvement in education	(a) First level					
	ROC 1 ER-M	0.79	1.900	2.90	1.100	2.60
	ROC 1 ER-F	0.76	3.000	4.90	1.800	3.50
	(b) Second level					
	ROC 2 ER-M	0.56	4.800	9.30	5.400	8.40
	ROC 2 ER-F	0.51	6.100	6.00	7.100	6.70
	(c) Third level					
	ROC 3 STUD	0.45	8.600	10.70	8.600	11.70
	TOTAL WT	3.07				
3. Financial commitment and emphasis	(a) Level					
	% GNP	0.56	2.900	1.400	4.100	1.70
	% Budget	0.46	12.800	5.800	16.200	6.10
	(b) Rate of change					
	ROC % GNP	0.58	4.900	19.600	5.200	21.70
	ROC % Budget	0.67	0.900	6.700	1.100	7.30
	TOTAL WT	2.27				
4. Extent and refinement of basic education	2/1 M	0.90	0.190	0.030	0.300	0.04
	2/1 F	0.87	0.170	0.040	0.284	0.04
	SPEC/1	0.65	0.002	0.010	0.002	0.01
	% 2 MTT	-0.59	2.400	2.900	2.710	4.10
	% 2 FTT	-0.52	8.300	10.600	4.930	6.50
	Act/exp 1	-0.58	0.134	0.037	0.125	0.27
	TOTAL WT	4.11				
5. Female involvement in education	% F-P 1	0.67	46.10	6.100	44.130	8.10
	% F-P 2	0.81	42.00	10.300	40.340	11.30
	% F-P 3	0.75	28.40	9.400	29.220	12.70
	% F-T 1	0.83	61.60	20.300	53.910	24.40
	% F-T 2	0.84	36.50	12.900	37.050	13.70
	TOTAL WT	3.90				
6. Extent of preschool provision	P/1 M	0.75	0.031	0.02	0.037	0.08
	P/1 F	0.77	0.033	0.02	0.039	0.08
	TOTAL WT	1.52				
7. Extent of second-level education	% 2 M gn	0.84	65.900	20.900	71.700	22.0
	% 2 F gn	0.85	66.900	19.800	74.000	20.9
	TOTAL WT	1.69				

Appendix II

Indicator	Defining variables	Recommended weights	Mean 1/	Standard Deviation	Mean 1/	Standard Deviation
8. Extensiveness of third level educational development	3/2 M	0.58	0.150	0.12	0.151	0.15
	3/2 F	0.51	0.079	0.11	0.092	0.14
	Home/abd 3	0.51	31.600	12.5	12.000	12.20
	ROC 2/1 M	-0.54	4.400	6.7	3.900	4.90
	ROC 2/1 F	-0.52	4.600	7.7	5.000	5.80
	TOTAL WT	2.66				
9. Orientation of courses studied by students at the third level	(a) Emphasis on Humanities/Education/Fine Arts Courses					
	% 3 M HEF	-0.65	22.900	14.4	26.200	16.1
	% 3 F HEF	-0.71	49.100	18.4	48.600	19.7
	(b) Emphasis on Law/Social Science Courses					
	% 3 M LSS	0.71	28.800	15.2	28.900	13.0
	% 3 F LSS	0.81	19.200	12.0	22.200	4.0
	TOTAL WT	2.88				

1/ In some instances, medians rather than mean values are reported. The standard deviation is then an estimate based on a restricted range.

2/ The values for the total weights are chosen on the basis of certain assumptions - in particular that the inter-correlations between all variables are equal to unity. To the extent this assumption is violated, the totals given over-estimate the real values. However, such error will not severly distort the values calculated for the present indicator set.

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OCCASIONAL PAPER No. 41: discusses the problems of the development and use of educational system indicators after postulating a framework within which indicators should be developed, the paper proposes a set of 10 indicators on the basis of previously conducted empirical research. Various ways in which these indicators can be used to measure and demonstrate educational change are also discussed.

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